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NGUYEN, HA T	

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BEFORE THE BOARD OF PATENT APPEALS

AND INTERFERENCES

Application Number: 10/679,144

Filing Date: October 03, 2003

Appellant(s): AGGARWAL ET AL.

Rose Alyssa Keagy

For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed December 14, 2005 appealing from the Office action mailed 07-27-05.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The following are the related appeals, interferences, and judicial proceedings known to the examiner which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal:

The parent case is currently under appeal and its status is "On Appeal Awaiting Decision by the Board of Appeals" in Private PAIR. The application number of the parent case is 10/356,114 and it was filed 01-30-2003. The appeal number is 2006-0650. Jennifer M. Kennedy is the Examiner for the parent and for this application.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6730354	Gilbert et al.	5-2004
6350644	Sakurai	2-2002
6444478	Basceri et al.	9-2002
6114199	Isobe et al.	9-2000
5,873,977	Deso et al.	2-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action.

A person shall be entitled to a patent unless -

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if le international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 74-76, 80-85, 87-91, 93-95, and 97 are rejected under 35 U.S.C. 102(e) as being anticipated by Basceri et al. (U.S. Patent No. 6,444,478).

In re claims 74 and 75, Basceri et al. discloses the PZT film prepared in accordance with the method comprising: forming a front-end structure over a semiconductor substrate (30, see explanation of substrate assembly, column 5, lines 32-45); forming a bottom electrode (32) over said front-end structure; preheating said semiconductor wafer (see column 7, lines 10 through column 8, lines 55); and forming a PZT film (see column 6, line 44 through column 7, line 5) over said bottom electrode; wherein said preheating step comprises placing said semiconductor wafer on a heater, and heating said semiconductor wafer in an ambient comprised of a mixture of an inert gas and an oxidizer gas (see column 8, lines 43-55 and column 9, lines 25-47, Pb being applied to example with Ti).

In re claim 76, Basceri et al. further discloses wherein the preheating step can be performed in a vacuum (see column 9, lines 15-25).

In re claims 80-82, and 87-89, Basceri et al. discloses the PZT film formed wherein said preheating step comprises heating said semiconductor wafer in an ambient comprised of a mixture of an inert gas of any one of He, Ar or N_2, and an oxidizer gas of any one of O_2, N_2O, and O_3 (see column 8, lines 43-55 and column 9, lines 25-47, Pb being applied to example with Ti).

In re claims 83-85, 90-91, 93-95, and 97, Basceri et al. also discloses wherein Ar comprises at least 20% (500 sccm) of the flow of inert/oxidizer gas mixture (where the oxidizer gas can be supplied anywhere from 1 to 5000 sccm), wherein the PZT film contains at least 2% excess Pb from the stoichiometric composition, wherein the PZT film is $PbZrO_3$, wherein the PZT film is $PbTiO_3$, wherein the PZT film is a solid solution of the component end members $PbZrO_3$, and PbTi O_3 (see column 6, line 44 through column 7, line 5, Pb being applied to example with Ti).

While Basceri et al. does not specifically state the PZT film is $PbZrO_3$, the examiner notes that a PZT film must contain some titanium and some zirconium in order to be a PZT film (lead zirconium titanate) therefore, the examiner takes Gilbert et al. disclosure of a Pb(Zr, Ti)O_3 (see column 1 , line 1-5) film to read on the limitation of the PZT film being $PbZrO_3$ or $PbTiO_3$.

The examiner notes claims 74-76 and 80-97 are product-by-process claims. Product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the

product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

3. Claims 74-75, 80-82, 84-85, 87-91, and 93.are rejected under 35 U.S.C. 102(e) as being anticipated by Gilbert et al. (U.S. Patent No. 6,730,354).

Gilbert et al. discloses the PZT film prepared in accordance with the method comprising: forming a front-end structure over a semiconductor substrate (22), forming a bottom electrode over said front-end structure (see column 4, line 62 through column 5, line 5); preheating said semiconductor wafer containing said electronic device (bottom electrode), wherein said preheating step comprises placing said semiconductor wafer on a heater, and heating said semiconductor wafer in an ambient comprised of a mixture of an inert gas of any one of He, Ar or N_2, and an oxidizer gas of any one of O_2, N_2O, and O_3, (see column 6, line 54 through column 7, line 13, and column 3, lines 13-55) ; and forming a PZT film (see column 7, lines 14-31 and column 2, lines 54-60) over said bottom electrode.

In re claims 84 and 90, Gilbert et al. disclose the device wherein the PZT film contains at least 2% excess Pb from the stoichiometric composition of $Pb_{1.0}$ $(Zr,Ti)_{1.0}$ O_3 (see column 7, line 13 to column 8, Line 6 and specifically Figure 5, wherein the preferred gas ratio Pb/ Zr +Ti of 1 .00 to 1 .07 shows a film containing a Pb/Zr +Ti ratio of approximately 1.1).

In re claims 85, 91, and 93, Gilbert et al. disclose the device wherein said stoichiometric PZT film is $PbZrO_3$, wherein said stoichiometric PZT film is $PbTiO_3$, wherein said stoichiometric PZT film is a solid solution of the component end members $PbZrO_3$ and $PbTiO_3$.

While Gilbert et al. does not specifically state the PZT film is either $PbZrO_3$ or $PbTiO_3$, the examiner notes that a PZT film must contain some titanium and some zirconium in order to be a PZT film (lead zirconium titanate) therefore, the examiner; takes Gilbert et al. disclosure of a $Pb(Zr, Ti)O_3$ (see column 1, line 1-5) film to read on the limitation of the PZT film being $PbZrO_3$ or $PbTiO_3$.

The examiner notes that Merriam-Webster's Collegiate Dictionary, Tenth Edition defines solution as an act or the process by which a solid, liquid or gaseous substance is homogenously mixed with a liquid or sometime a gas or solid, or a homogenous mixture formed by this process. The examiner notes that $Pb(Zr, Ti)\ O_3$ is a solid solution of the component end members $PbZrO_3$ and $PbTiO_3$.

The examiner notes claims 74-76 and 80-97 are product-by-process claims. Product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir.

1985).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action;

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentabililty shall not be negatived by the manner in which the invention was made.

5. Claims 86, 92, and 96 are rejected under 35 U.S.C. 103(a) as being unpatentable over Basceri et al. (U.S. Patent No. 6,444,478).

Basceri et al. discloses the device substantially as claimed and rejected above, including having a La doped PZT film, but does not disclose the method wherein wherein the PZT film is doped up to 5%.

The examiner notes that Applicant does not teach that the dopant concentration range solves any stated problem or are for any particular purpose. Therefore, the dopant concentration range lacks criticality in the claimed invention and does not produce unexpected or novel results. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to doped the PZT film with La up to 5%, since as Basceri et al. teaches the dopant concentration could be controlled

in order to prevent degradation of the dielectric film and doping the PZT film is known to improve fatigue characteristics of the film, and because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller* 105 USPQ 233, MPEP 2144.05 II A.

6. Claim 83 is rejected 35 U.S.C. 103(a) as being unpatentable over Gilbert et al. (U.S. Patent No. 6,730,354).

Gilbert disclose the device as claimed and rejected above, but does not disclose the method wherein the Ar comprises at least 20% of the flow of the said inert/oxidizer gas.

The examiner notes that Applicant does not teach that the Ar flow rate of at least 20% solves any stated problem or is for any particular purpose. Therefore, the flow rate lacks criticality in the claimed invention and do not produce unexpected or novel results. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the preheating step with an Ar flow rate at least 20%, since the invention would perform equally well to allow for a gradually heating of the substrate to prevent incidence of thermal shock which may cause the substrate to break and throughput to be minimized (see Gilbert et al., column 6, lines 54-65) and because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller* 105 USPQ 233, MPEP 2144.05 II A.

7. Claims 86 and 92 are rejected 35 U.S.C. 103(a) as being unpatentable over Gilbert et al. (U.S. Patent No. 6,730,354) in view of Sakurai (U.S. Patent No. 6,350,644).

Gilbert et al. disclose the device as claimed and rejected above, but does not disclose the method wherein the PZT film is doped up to 5% with either La or Nb. Sakurai discloses the method wherein the PZT film is doped up to 5% with either La or Nb (see column 4, lines 10-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to dope the PZT film as Sakurai discloses because doping with La or Nb is known in the art to improve fatigue characteristics and reduce leakage current.

8. Claims 76, and 95-97 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sakurai (U.S. Patent No. 6,350,644) in view of Isobe et al. (U.S. Patent No. 6,1 14,199)

In re claim 76 , Sakurai discloses the PZT film prepared in accordance with the method comprising forming a bottom electrode over said a substrate (see column 2, line 65 through column 3, line 22 and column 7, lines 40-45); preheating said semiconductor wafer (column 7, lines 40-45), wherein said preheating step comprises placing said semiconductor wafer on a heater, and heating said semiconductor wafer in a vacuum (see column 7, lines 40-45); and forming a PZT film (see column 7, lines 45-52) over said bottom electrode.

Sakurai discloses the device as claimed and rejected above including the method wherein the ferroelectric material is used in a DRAM or FRAM (see column 2, lines 20-23), but does not disclose the method wherein the bottom electrode is formed over a front-end structure. Isobe et al. discloses the device of forming transistors (12, 13) and then forming a bottom electrode (22) over the transistor, and therefore, a bottom electrode is disclosed as being formed over a front-end structure. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the bottom electrode over a front-end structure as Isobe et al. teaches, in the method of Sakurai, in order to drive current and provide an operable device.

In re claims 95 and 97, Sakurai disclose the device wherein said stoichiometric PZT film is $PbZr\ O_3$, wherein said stoichiometric PZT film is $PbTi\ O_3$, wherein said stoichiometric PZT film is a solid solution of the component end members $PbZr\ O_3$ and $PbTi\ O_3$.

While Sakurai does not specifically state the PZT film is either $PbZr\ O_3$ or $PbTi\ O_3$, the examiner notes that a PZT film must contain some titanium and some zirconium in order to be a PZT film (lead zirconium titanate) therefore, the examiner takes Sakurai disclosure of a $Pb(Zr, Ti)O_3$ (see column 4, lines 4-20) film to read on the limitation of the PZT film being $PbZrO_3$ or $PbTiO_3$.

The examiner notes that Merriam-Webster's Collegiate Dictionary, Tenth Edition defines solution as an act or the process by which a solid, liquid or gaseous substance is homogenously mixed with a liquid or sometimes a gas or solid, or a homogenous mixture formed by this process. The examiner notes that $Pb(Zr, Ti)O_3$ is a solid solution

of the component end members $PbZrO_3$ and $PbTiO_3$.

In re claim 96, Sakurai disclose in one embodiment the device as claimed and rejected above, but do not disclose the device wherein the PZT film is doped up to 5% with either La or Nb. Sakurai discloses in another general embodiment the device wherein the PZT film is doped up to 5% with either La or Nb (see column 4, lines 10-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to dope the PZT film as Sakurai discloses because doping with La or Nb is known in the art to improve fatigue characteristics and reduce leakage current.

9. Claim 94 is rejected 35 U.S.C. 103(a) as being unpatentable over Sakurai (U.S. Patent No. 6,350,644) and Isobe et al. (U.S. Patent No. 6,1 14,199) in view of Gilbert et al. (U.S. Patent No. 6,730,354).

The combined Sakurai and Isobe et al. disclose the device as claimed and rejected above, but do not disclose the device wherein the PZT film contains at least 2% excess Pb from the stoichiometric composition of $Pb_{1.0}(Zr,Ti)_{1.0}O_3$.

Gilbert et al. discloses the device wherein the PZT film contains at least 2% excess Pb from the stoichiometric composition of $Pb_{1.0}(Zr,Ti)_{1.0}O_3$ (see column 7, line 13 to column 8, line 6 and specifically Figure 5, wherein the preferred gas ratio Pb/ Zr+Ti of 1.00 to 1 .07 shows a film containing a Pb/Zr +Ti ratio of approximately 1 .1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a PZT layer of Sakurai with excess lead, because as Gilbert et al. teaches the material formed has excellent electrical properties.

(10) Response to Arguments

1. In re claims 74-76, 80-85, 87-91, 93-95, and 97, Appellants argue that Basceri et al. does not teach the formation of a haze free PZT film, the use of a preheat step and the details about the conditions of the pre-heating step, because Basceri et al. teaches a film deposition process that does not include a preheat step only the film forming step. Initially, the examiner would like to point out that, "haze free PZT film" has not been given patentable weight because the recitation occurs in the preamble. A preamble is generally not accorded any patentable weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (UCPA 1976) and Kropa v. Robie, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951). The examiner notes that the body of the claims does not refer back to the preamble. Although the term "haze free PZT film" has not been given patentable weight, the references relied upon by the examiner, including Basceri, do indeed form a haze free PZT film since they include the method of preheating prior to forming the PZT film which is taught by Appellants to form a haze free PZT film (see Specification, page 5, lines 1-15). Specifically in column 7, lines 26-34, Basceri discloses that "The precursor is contacted with a **surface which has been heated** to a temperature above the decomposition temperature of the precursor", this means that before the forming the PZT film the substrate has been pre-heated, this corresponds to the claimed pre-

heating step. Further the examiner notes that before the precursor is introduced the chamber contains at least some residual air, which contains nitrogen, oxygen (an oxidizer), and inert gases. Besides, Basceri discloses the use of a vacuum chamber at a low pressure (see col. 9, lines 15-25). In re claims 80-82, and 87-89, Basceri et al. discloses the PZT film formed wherein said preheating step comprises heating said semiconductor wafer in an ambient comprised of a mixture of an inert gas of any one of He, Ar or N_2, and an oxidizer gas of any one of O_2, N_2O, and O_3 (see column 8, lines 43-55 and column 9, lines 25-47, Pb being applied to example with Ti). In re claims 83-85, 90-91, 93-95, and 97, Basceri et al. also discloses wherein Ar comprises at least 20% (500 sccm) of the flow of inert/oxidizer gas mixture (where the oxidizer gas can be supplied anywhere from 1 to 5000 sccm), wherein the PZT film contains at least 2% excess Pb from the stoichiometric composition, wherein the PZT film is $PbZrO_3$, wherein the PZT film is $PbTiO_3$, wherein the PZT film is a solid solution of the component end members $PbZrO_3$, and PbTi O_3 (see column 6, line 44 through column 7, line 5, Pb being applied to example with Ti). While Basceri et al. does not specifically state the PZT film is $PbZrO_3$, the examiner notes that a PZT film must contain some titanium and some zirconium in order to be a PZT film (lead zirconium titanate), in a normal stoichiometric composition PZT stands for Pb(Zr, Ti)O_3 film or comprising $PbZrO_3$ or $PbTiO_3$ (The reference Gilbert et al. is cited to show this fact, see column 1, line 1-10). In Pb(Zr, Ti) O_3 , the components $PbZrO_3$ and $PbTiO_3$ are homogenously mixed due to the same bonding electronic configuration of Zr and Ti. The examiner notes Appellants' objection to the use of Gilbert in the rejection of claims 95 and 97 over Basceri et al.

under 35 U. S. C. 102(e). However, Gilbert et al. is here used only to show that the name PZT means $Pb(Zr, Ti)O_3$, a composition of $PbZrO_3$ or $PbTiO_3$ depending on the actual concentration of Zr or Ti in PZT, when the concentration of Ti or Zr is negligible, PZT would be $PbZrO_3$ or $PbTiO_3$, respectively [actually this is also shown in Basceri et al. (col. 6, lines 61-62)].

The examiner notes claims 74-76 and 80-85, 87-91, 93-95, and 97 are product-by-process claims. Product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

2. In re claims 74-75, 80-82, 84-85, 87-91, and 93, Appellants also argue that Gilbert et al. does not teach the formation of a haze free PZT film. The examiner notes, that although the term "haze free PZT film" has not been given patentable weight, the references relied upon by the examiner, including Gilbert et al., do indeed form a haze free PZT film since they include the method of preheating prior to forming the PZT film which is taught by Appellants to form a haze free PZT film (see page 5, lines 1-15). Further, Appellants argue that Gilbert et al. teaches away form the invention because

Gilbert et al. requires that the wafer be suspended by lift pins over "susceptor 24" but not on the heater, as claimed. Further, the examiner maintains that Gilbert et al. teaches the wafer to be on the heater as claimed since the term "on" does not require direct contact. Appellants also argue that in column 6, line 54 through col. 7 lines 14-15 Gilbert teaches a preheat step with no gases present (col. 6, lines 54-55, col. 7, lines14-15) and in col. 3, lines 13-55 Gilbert et al. teaches the use of oxidizing co-reactant gas and a purge gas during PZT deposition but not during a pre-heat step. The examiner disagrees, note that even though in col. 6, line 55-col. 7, line 15, Gilbert et al. does not mention any gas, this does not mean that no gas is present because in col. 3, lines 43-56, Gilbert discloses the use of Ar, He, O_2 (an oxidizer), and N_2 **during the pre-heating and heating process**.

Appellants argue that Gilbert does not teach the PZT film containing at least 2% excess Pb from the stoichiometric composition of $Pb_{1.0}(Zr,Ti)_{1.0}O_3$, PZT to be a solid solution of the component end members $PbZrO_3$ and $PbTiO_3$ While Gilbert et al. does not specifically state the PZT film is either $PbZrO_3$ or $PbTiO_3$, the examiner notes that a PZT film must contain some titanium and some zirconium in order to be a PZT film (lead zirconium titanate) therefore, the examiner takes Gilbert et al.'s disclosure of a Pb(Zr, Ti)O_3 (see column 1, line 1-10) film to read on the limitation of the PZT film being $PbZrO_3$ or $PbTiO_3$. PZT means Pb(Zr, Ti)O_3 , a composition of $PbZrO_3$ or $PbTiO_3$ depending on the actual concentration of Zr or Ti in PZT, when the concentration of Ti or Zr is negligible, PZT would be $PbZrO_3$ or $PbTiO_3$, respectively. Gilbert et al. disclose the method wherein the PZT film contains at least 2% excess Pb from the stoichiometric

composition of $Pb_{1.0}(Zr,Ti)_{1.0}O_3$ (see column 7, line 13 to column 8, line 6 and specifically Figure 5, wherein the preferred gas ratio Pb/ Zr +Ti of 1.00 to 1.07 shows a film containing a Pb/Zr +Ti ratio of approximately 1.1).

The examiner notes that Merriam-Webster's Collegiate Dictionary, Tenth Edition defines solution as an act or the process by which a solid, liquid or gaseous substance is homogenously mixed with a liquid or sometimes a gas or solid, or a homogenous mixture formed by this process. The examiner notes that Pb(Zr, Ti) O_3 is a solid solution of the component end members $PbZrO_3$ and $PbTiO_3$.

Again, the examiner notes that claims 74-75 and 80-82, 84-85, 87-91, 93 are product-by-process claims. Product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps."[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

Therefore, Gilbert does teach all the limitations of claims 74-75, 80-82, 84-85, 87-91, and 93.

3. In re claims 86, 92, and 96, Appellants argue that Basceri does not disclose that the PZT film is doped up to 5% with either La or Nb. The examiner notes that Applicant

does not teach that the dopant concentration range solves any stated problem or are for any particular purpose. Therefore, the dopant concentration range lacks criticality in the claimed invention and does not produce unexpected or novel results. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to doped the PZT film with La up to 5%, since as Basceri et al. teaches the dopant concentration could be controlled in order to prevent degradation of the dielectric film and doping the PZT film is known to improve fatigue characteristics of the film, and because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller* 105 USPQ 233, MPEP 2144.05 II A.

4. In re claim 83, Appellants argue that Gilbert et al. does not disclose that Ar comprises at least 20% of the flow of said inert/oxidizer gas mixture in the preheat step and traverse the examiner's statement "that Applicant does not teach that the Ar flow rate of at least 20% solves any stated problem or is for any particular purpose" and that "the flow rate lacks criticality in the claimed invention and do not produce unexpected or novel results". The Appellants point to pages 5 and 6 to show support for the criticality where Appellants state that "because of the preheat step that was performed in accordance with the invention hereinabove, a haze free, phase pure PZT film is now formed..." (See Specification, page 5, lines 15-17) and "By performing the preheat step in accordance with the present invention, the stoichiometric PZT film that forms the capacitor dielectric, 3, has desirable endurance, durability, and reliability" on

page 6 (See Specification, lines 16-20). The examiner notes that Appellants' specification on page 5, lines 5-10, also state that while the best mode of the invention is a combination of Ar and O_2 (whereby Ar comprises at least 20% of the total gas flow) that "the use of other inert gases such as He, N_2, or only Ar, is within the scope of this invention" and that "it is within the scope of this invention not to use any gas during the preheat step, rather the preheat step is performed by a vacuum in the MOCVD chamber". Appellants' citation of page 5, lines 15-17, to support criticality, refers back to all of the aforementioned methods, including to an embodiment that does not require any argon at all, and yet still achieves the advantages of a haze free, phase pure PZT film. Therefore, the examiner submits that Appellants teach that concentration of Ar in the flow rate is not critical.

5. In re claims 86 and 92, Appellants argue that Gilbert et al. does not teach the PZT film being doped up to 5% with either La or Nb and Sakurai does not teach the formation of a haze free PZT film because Sakurai does not teach a pre-heating step. Note that appellants' arguments are largely directed to what the cited references teach individually. However, it is axiomatic that one cannot show nonobviousness by attacking references individually where the rejection, as here, is based on a combination of references. *In re Young*, 403 F.2d 754, 159 USPQ 725 (CCPA 1968); *In re Keller*, 642 F.2d 413,208 USPQ 871 (CCPA 1981). For example, applicant argues that Sakurai does not disclose a pre-heating step as here claimed. However, Gilbert, not Sakurai, is employed in the rejection to show that feature of the claimed process. Appellants also

argue that there is no logic in the combination of Gilbert with Sakurai because Sakurai does not teach a preheat step. The examiner disagrees, the expectation of some advantage is the strongest rationale for combining references (MPEP 2144), in this combination the advantages are to improve fatigue characteristics and to reduce leakage current.

Appellants argue that col. 4, lines 10-20 of Sakurai does not teach the recited doping of La or Nb up to 5%. The examiner notes that Sakurai disclose in column 4 lines 10-15, the stoichiometry of $(Pb_{1-x}M_x)(Zr_y Ti_{1-y}) O_3$ wherein the M is La and x is anywhere for 0 to 0.2 and y is anywhere from 0.05 to 0.6 which allows for La to be doped up to 5% as claimed. For example, if x=0.1 and y=0.4 then the stoichiometry becomes: $(Pb_{0.9}M_{0.1}) (Zr_{0.4}Ti_{0.6}) O_3$ which can be read as: $(Pb_{0.9}M_{0.1})_1(Zr_{0.4}Ti_{0.6})_1O_3$ (the stoichiometry of the metals within the parentheses being a 1:1 ratio, as supported in example 2, column 8, lines 50-55). Thus, with 0.1 mol of La to 5 total mol of elements the La concentration is $\frac{0.1mol}{5mol}\times 100$ percent =2 percent La. This satisfies the claimed condition of doping up to 5% La or Nb.

6. In re claims 76 and 95-97, Appellants argue that Sakurai and Isobe et al. either alone or in combination does not teach the formation of a haze free PZT film, Sakurai et al. does not teach a haze free PZT film because the process does not include a preheating the wafer. The examiner disagrees, initially, the examiner would like to point out that, "haze free PZT film" has not been given patentable weight because the recitation occurs in the preamble. A preamble is generally not accorded any patentable

weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (UCPA 1976) and Kropa ?. Robie, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951). The examiner notes that the body of the claims do not refer back to the preamble. Although the term "haze free PZT film" has not been given patentable weight, the references relied upon by the examiner, including Sakurai, do indeed form a haze free PZT film since they include the method of preheating prior to forming the PZT film which is taught by Appellants to form a haze free PZT film (see page 5, lines 1-15). Specifically, the examiner notes that before the precursor is introduced the chamber contains Sakurai discloses forming a Pt thin film at a temperature of 600C in vacuum before depositing the PZT film (see col. 7. lines 40-45), even though this is the step of forming the Pt bottom electrode, this step also heat the substrate before the PZT deposition, it is interpreted to be equivalent to the claimed pre-heating step. The claims do not preclude this interpretation.

Appellants also argue the combination of Isobe et al. with Sakurai, stating the Isobe et al. does not teach forming a haze free PZT film, nor would it be logical to combine the method of forming Bi-based layer ferroelectric with a method of making a PZT. The examiner notes that Isobe was not relied upon to show formation of a PZT film. Sakurai was relied upon to disclose the method of forming a PZT film. Rather, Isobe et al. was relied upon for forming the front-end structure. In response to Appellants' arguments against the references individually, one cannot show

nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Besides, the expectation of some advantage is the strongest rationale for combining references (MPEP 2144), in this combination the advantage is to drive current and provide an operable device.

Regarding the specific features of claims 95-97, Appellants argue that Sakurai and Isobe et al. either alone or in combination does not teach a solid solution of the component end members $PbZrO_3$ and $PbTiO_3$. The examiner disagrees, Sakurai does disclose the method wherein said stoichiometric PZT film is $PbZrO_3$, wherein said stoichiometric PZT film is $PbTiO_3$, wherein said stoichiometric PZT film is a solid solution of the component end members $PbZrO_3$ and $PbTiO_3$. While Sakurai does not specifically state the PZT film is either $PbZrO_3$ or $PbTiO_3$, the examiner notes that a PZT film must contain some titanium and some zirconium in order to be a PZT film (lead zirconium titanate) therefore, the examiner takes Sakurai's disclosure of a $Pb(Zr, Ti)O_3$ (see column 4, lines 4-20) film to read on the limitation of the PZT film being $PbZrO_3$ or $PbTiO_3$. PZT means $Pb(Zr, Ti)O_3$, a composition of $PbZrO_3$ or $PbTiO_3$ depending on the actual concentration of Zr or Ti in PZT, when the concentration of Ti or Zr is negligible, PZT would be $PbZrO_3$ or $PbTiO_3$, respectively. The examiner notes that Merriam-Webster's Collegiate Dictionary, Tenth Edition defines solution as an act or the process by which a solid, liquid or gaseous substance is homogenously mixed with a liquid or sometimes a gas or solid, or a homogenous mixture formed by this process.

The examiner notes that Pb(Zr, Ti) O_3 is a solid solution of the component end members $PbZrO_3$ and $PbTiO_3$. In Pb(Zr, Ti) O_3 , the components $PbZrO_3$ and $PbTiO_3$ are homogenously mixed due to the same bonding electronic configuration of Zr and Ti. Appellants argue that col. 4, lines 10-20 of Sakurai does not teach the recited doping of La or Nb up to 5%. The examiner notes Sakurai disclose in column 4 lines 10-15, the stoichiometry of $(Pb_{1-x}M_x)(Zr_y Ti_{1-y}) O_3$ wherein the M is La and x is anywhere for 0 to 0.2 and y is anywhere from 0.05 to 0.6 which allows for La to be doped up to 5% as claimed. For example, if x=0.1 and y=0.4 then the stoichiometry becomes: $(Pb_{0.9}M_{0.1})$ $(Zr_{0.4}Ti_{0.6}) O_3$ which can be read as: $(Pb_{0.9}M_{0.1})_1(Zr_{0.4}Ti_{0.6})_1O_3$ (the stoichiometry of the metals within the parentheses being a 1:1 ratio, as supported in example 2, column 8, lines 50-55). Thus, with 0.1 mol of La to 5 total mol of elements the La concentration is $\frac{0.1mol}{5mol}\times 100$ percent =2 percent La. This satisfies the claimed condition of doping up to 5% La or Nb.

7. In re claim 94, Appellants argue that Sakurai, Isobe et al. or Gilbert et al. either alone or in combination do not teach the haze free PZT film containing at least 2% excess Pb from the stoichiometric composition of $Pb_{1.0}(Zr,Ti)_{1.0}O_3$ and it is not logical to combine Sakurai and Isobe et al. with Gilbert et al.. The examiner disagrees, claim 94 depends from claim 76, all the arguments concerning the limitations of claim 76 stated above also apply for claim 94. Besides, Gilbert et al. discloses PZT film containing at least 2% excess Pb from the stoichiometric composition of $Pb_{1.0}(Zr,Ti)_{1.0}O_3$ (see column 7, line 13 to column 8, line 6 and specifically Figure 5, wherein the preferred gas ratio

Pb/ Zr +Ti of 1.00 to 1.07 shows a film containing a Pb/Zr +Ti ratio of approximately 1.1). Besides, the expectation of some advantage is the strongest rationale for combining references (MPEP 2144), in this combination the advantage is to obtain material formed of excellent electrical properties.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Ha Nguyen

Primary Examiner

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Conferees:

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